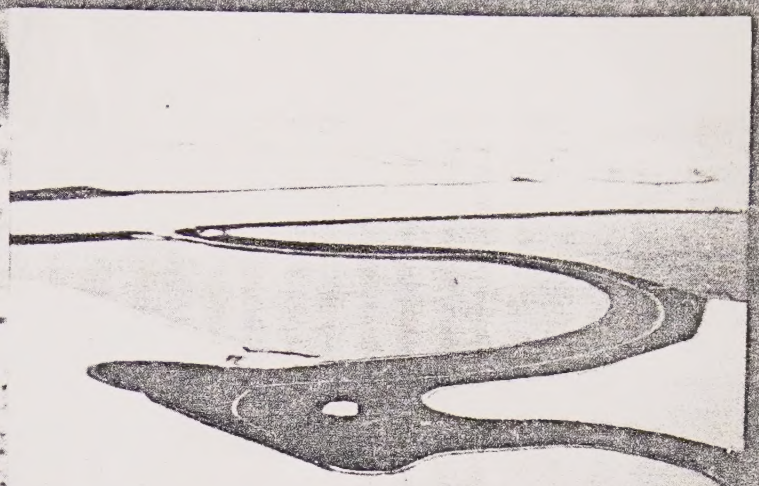
83 01974

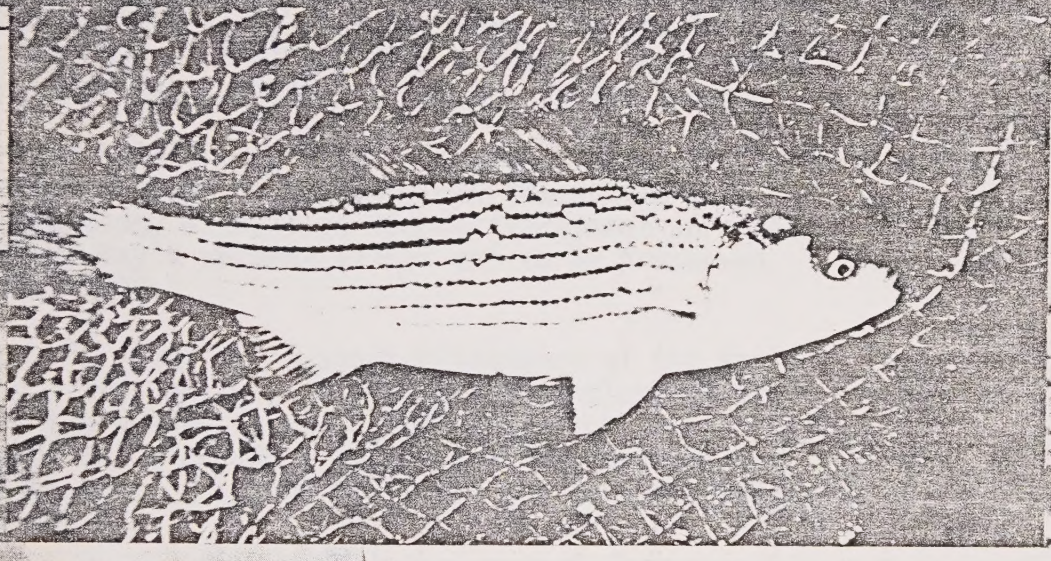


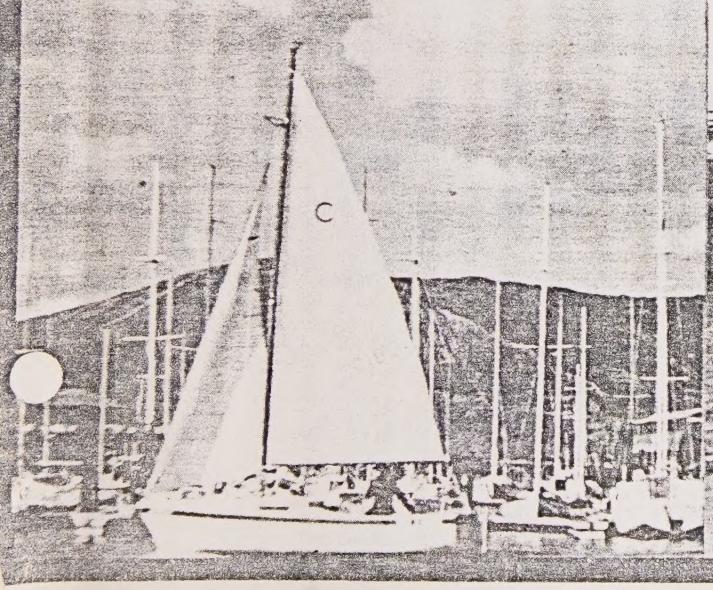
TRAGEDY OF THE BAY COMMONS

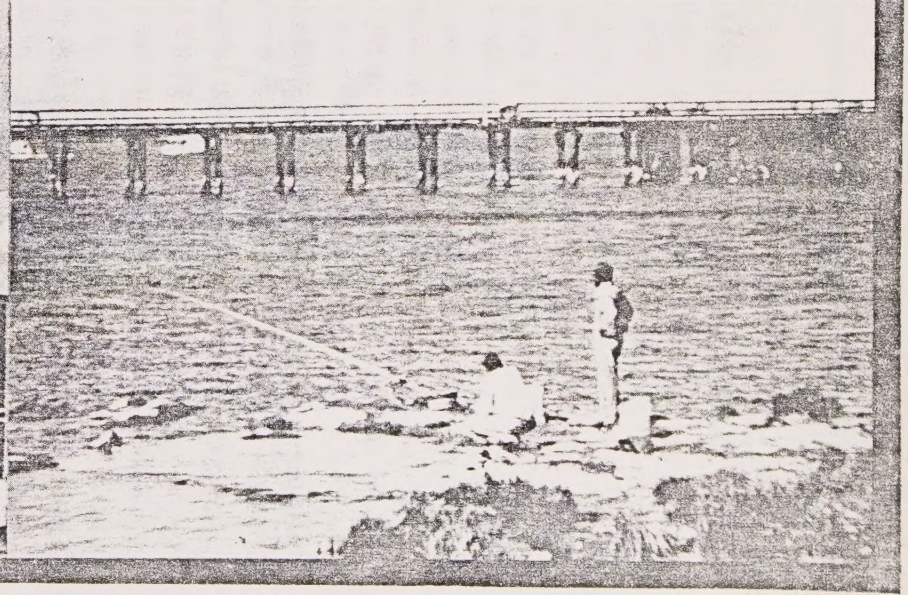
by WILLIAM T. DAVOREN

SAN FRANCISCO BAY

U S Fish and Wildlife Service







NOTE TO THE READER

San Francisco Bay has been taken for granted for so many years that it can now be said to be California's longest neglected water problem.. Even its pioneering shoreline environment controls, progressive by national standards only 10 years ago, today are considered archaic compared to the protections provided all other coastal wetlands of California. The old answers, part of this longtime neglect, are not working for the Bay. Official planning timeframes carry the Bay only 20 years into the future, at most, while more environmental changes -- especially upstream water developments -- run on without pause.

The Fish and Wildlife Service believes the Eighties must bring marked changes in applying new scientific and legal methodology as well as new institutional arrangements if the Bay's present values are to be preserved beyond Year 2000.

This paper is intended to spark discussion of the Bay's future in a new context. Although the conclusions are primarily the author's, and do not represent an official position of the Fish and Wildlife Service, both he and the Service solicit reactions to the opinions and judgments herein.

William D. Sweeney

William D. Sweeney
Area Manager California
U.S. Fish and Wildlife Service

U.S. Fish and Wildlife Service

Special Report

TRAGEDY OF THE BAY COMMONS

BY WILLIAM T. DAVOREN

Presented to the San Francisco Bay and Estuarine Association, June 25, 1980, during the 61st Annual Meeting of the Pacific Division, American Association for the Advancement of Science at Davis, California.

Released by

California Area Office

Sacramento, California

August, 1980

Second Printing - December, 1980

* * * * * * * * * * * *

The author is an environmental planning specialist of the U.S. Fish and Wildlife Service who has been involved in San Francisco Bay and California coastal planning issues since 1965. Single copies of the paper are available from the author at:
Bay Institute Office, c/o NMFS Laboratory
3150 Paradise Drive, Tiburon, California 94920
415-435-3149 or (FTS) 556-0565.

Cover photos provided by Save San Francisco Bay Association

Digitized by the Internet Archive
in 2024

https://archive.org/details/c124897611

Tragedy of the Bay Commons

By William T. Davoren

This paper accepts Hardin's dour but challenging maxim and finds that it can be applied to San Francisco Bay as well as to the number of sheep grazing the commons. Hardin might be saying, with only slight modifications as shown in parenthesis:

"Each man (agency) is locked into a system that compels him (it) to increase his (its) herd (program) (mission) (project) without limit -- in a world that is limited. Ruin is the destination toward which all men rush... Freedom in a commons (bay) brings ruin to all."

When Garrett Hardin presented his now legendary "Tragedy of the Commons" address to the AAAS in 1968 [1/], interest in San Francisco Bay's problems was approaching a summit. In three years the Save the Bay effort of 1965 had blossomed from a short-term legislative study to a temporary planning and permit agency with an impossible long name -- the San Francisco Bay Conservation and Development Commission (BCDC).

1/ The University of California-Santa Barbara biology professor was president that year of the Pacific Division of the American Association for the Advancement of Science (AAAS), which met at Logan, Utah on June 25, 1968. The Tragedy of the Commons was published in Science, December 1968, p. 1243 ff.

In 1969 BCDC and its shoreline plan became a permanent fixture on the bureaucratic skyline. That's how "Saving the Bay" was institutionalized, and more. The BCDC epic served not only as an inspiration but as a working mini-model for the budding Save the Coast movement of that day. On November 7, 1972 the California Coastal Zone Conservation Commission was born in the 5400 words of Proposition 20.

Supporters of Proposition 20 credited their own hard work for the victory, but also gave thanks for the heavy-handed advertising campaign of the Prop 20 opponents -- which gave them equal time on some TV stations and a backlash among the voters. The planning, permit control, and permanent agency pattern of BCDC was repeated for the 1,100 miles of coastline, affecting forever -- hopefully -- how State and Federal development agencies, the 15 counties, 43 municipalities and 5 port districts regard the renewable and non-renewable coastal resources under their control. With blood, sweat, tears, a few night sessions -- and a rescue effort involving a little known "liferaft" bill -- the Legislature established the California Coastal Commission in 1976. Governor Brown's signature made it the law for the Golden Shore of the Golden State. (Healy et al 1978)

An only-in-California story perhaps?

An aberration of the body politic, changing forever how we regard and, more importantly, how our public agencies manage our bays, coasts and estuaries?

A rebuttal to Hardin and his selfseeking herdsman destroying the common grazing grounds needed by all? Not really.

More likely it was, and is, the exception that proves the rule, especially as the rule is applied to San Francisco Bay. Unfortunately, San Francisco Bay was not included in the more rigorous requirements of Proposition 20, applied to the Coast from 1973 to 1976, nor in the 1976 California Coastal Act. Conservationists of 1972 did not want to place the Bay program in the hands of the voters in 1972, nor in the hands of the Legislature in 1976.

Today only a few housekeeping arrangements tie the two Commissions together, such as sharing the same federal funds source, going arm in arm to Sacramento to do battle with budgetmakers or legislative committees, or sharing and swapping some coastal zone planning specialists upon occasion to meet some requirement of the Federal grant agency or a State government need.

The Proposition 20 wave simply did not splash into the Bay. BCDC continues today older and wiser, but with only the same basic program its' advocates won from the Legislature and Governor Reagan in 1969. It still administers the complex, patchwork shoreline use plan that was approved in 1969, and has not garnered any new authority to deal with applicants, local jurisdictions or with State and Federal agencies.[2/]

[2/] Two exceptions must be noted: (1) In 1977 BCDC's jurisdiction was expanded by the Legislature to include Suisun Marsh and surrounding buffer zone lands, in a joint plan with the Department of Fish and Game. BCDC actions there require local government compliance similar to the Coastal Commissions' powers. (2) Under the Federal Coastal Zone Management Act, BCDC gained some responsive authority over the actions of Federal agencies via the (disputed) Section 307 requirements for "Federal consistency" with approved State plans.

Though it has not happened yet, the only tangible fallout for the Bay and BCDC from the Proposition 20 coastal era will arrive when BCDC becomes eligible for the land planning study grants, restoration and other programs of the State Coastal Conservancy (SCC).[3] This may happen in 1980, if AB 2741 gains State Senate approval comparable in form to what passed the Assembly earlier this year. Coupled with the 1980 Nejedly Parks Bond Act, if approved by the voters in November, SCC participation can give BCDC and the Bay Area and its wetland habitats -- starting in 1981 -- the same types of benefits this imaginative program has brought to coastal lands and wetlands since 1977.

Reflecting on the above, and using Hardin's metaphor, I believe that we are flirting with the ruin of San Francisco Bay for the following reasons:

(1) because the pioneering, but limited and shoreline-oriented, program of BCDC never grew beyond the 1969 levels of coastal land use law; [4]

---

[3] The State Coastal Conservancy (SCC) was the second leg on the three-legged stool the Legislature built for the coast in 1976. The first leg was the California Coastal Act, covering the coast commission and its powers. The third leg was the park bond issue that year, which contained $10 million in seed money for the SCC along with authorizing many acquisitions in the coastal zone. The SCC, an innovation nationally when it began, allows State land managing agencies to work closely with the coast commission and other agencies in making land purchases, exchanges or leases -- including less than fee purchases -- plus providing funds for restoration and for coastal wetlands research.

[4] In an analysis done in 1978, the author concluded that BCDC has effective land use control over only 26.6 percent of the Bay's shoreline. This figure includes the areas within the so called Designated Priority Use category of the approved 1969 plan. BCDC's permit control in the remaining 73.4 percent of the Bay's shoreline computes as follows: Tidal Marsh and Undesignated shorelines shown in the plan, permit control over a 100-foot wide band but good only for requiring public access, 25 percent; Saltpond-Managed Wetlands, with permit control only covering the Bay-facing first dike, 15.1 percent; "Certain Waterways," where control applies only to mean higher high water (MHHW) or to five feet above mean sea level (MSL), 33.3 percent. The study did not attempt to measure the shorelines of upstream portions of local tributaries, which are totally excluded from BCDC permit control in the 1969 plan, or the Susisun Marsh area added to BCDC's jurisdiction in September 1977. See U S F W S letter to William Travis, California Coastal Commission March 23, 1978.

(2) because the one agency (BCDC) the public believes does control the destiny of the Bay does not begin to have the land or water use powers it would need to do that effectively; and

(3) because the daily management, and future values, of the Bay as a body of water are controlled by a myriad of Federal, State and Local agencies operating fragmented, linear programs that impact the Bay, for both good and bad, in a haphazard, discontinuous, and frequently counterproductive manner.

Hardin -- On responsibility, Hardin quotes Charles Frankel the philosopher: "Responsibility is the product of definite social arrangements;" and adds "note that Frankel calls for social arrangement -- not propaganda."

Saving the Bay Once, Twice, Thrice?

Despite its shortcomings by today's standards, the Save the Bay effort of the Sixties remains the only deliberate attempt of the past 40 years (1) to understand the Bay's ecological and systemic needs, at least partially, and (2) to devise ways and means to protect the Bay for the intrinsic values the Bay itself offers to present and future generations. Other than the BCDC experience, circa 1965-1969, altruism on the Bay is dead and has been for a long time.

The driving force behind all other appraisals of the Bay's biophysical, hydraulic, or chemical properties, or of its economic, social or legal values, can be traced directly to a project, a policy, an agency mission, or a public or private proposal to use, change or abuse the Bay in some way.[5/]

There have been hundreds of these, ranging from airport expansion to wastewater export -- in other words, from putting more fill in the Bay to removing new freshwater sources for the Bay.

Aside from BCDC the postwar benchmark studies of the Bay that, together, document how much we supposedly know about the Bay, in terms of what we plan for the Bay's future, are:

The Reber Plan (Bay Barriers)

1940-1960 This dominated Bay physical planning for 20 years, perhaps longer.

Purpose: To "simply dam off the north and south arms of the Bay and turn the impoundments into fresh water that could be sent all over California....the broad dams would accomodate railroads and highways" (Hedgpeth 1979).

5/ Immediate objections to this statement may be raised by all who believe it ignores the scientific research being performed by the U.S. Geological Survey, other basic data collection agencies such as National Oceans Survey, and -- presumably -- some untainted academic researchers in Bayside Colleges and Universities. The statement does ignore such worthwhile work, for two reasons: (1) it does not fit within the criteria of "deliberate" and the decision context stated above; (2) even when such empiric work is available it is not used in public decisionmaking if it collides with public projects already well down the developmental path, or it is simply ignored or filtered out of the information presented to political decisionmakers in Sacramento or Washington D.C. whenever the Bay's future is involved. Classic examples of (2) occurred in 1970 and in 1978.

Results: Shelves full of engineering and economic reports, construction of the Corps of Engineers Bay Model, and some peripheral biological studies that later helped fuel the Save the Bay movement of the Sixties.

Judgment: "...an elaborate plan to destroy San Francisco Bay" (Hedgpeth 1979).

The SERL Studies

1958-1964 (Sanitary Engineering Research Laboratory, University of California, Berkeley)

SERL started with a pilot study of South Bay, then sampling expanded north to Antioch Bridge, for the State Water Pollution Control Board.

Purpose: to investigate "the possible adverse effects of water pollution on the water quality characteristics and the fishery resources of San Francisco Bay."

Results: "...the prinicpal problems in the San Francisco Bay Area (sic) relate to those of aesthetics, principally floatable matter, oil and grease, acute toxicity of a variety of types and sources, and the potential of excessive enrichment resulting from unidentified growth-rate controlling biostimulants and/or nutrients. The SERL study made a start at identifying these problems " (Pearson 1972) (emphasis supplied).

The SERL studies also produced a "diversity index" to measure the "health" of the environment. "What seemed to be a useful, comparatively simple number turned out to be useless because

there is no demonstrable relation between 'health' and diversity, and the index per se was invalid...Yet the index almost became a requirement of waste-water discharge" (Hedgpeth 1979).

Judgment: "Unfortunately, a classic example of the results of haste combined with lack of ecological sophistication, engendered by limited time and the requirement to produce paper " (Hedgpeth 1979).

Kaiser Engineers Reports

1965-1969 (San Francisco Bay-Delta Water Quality Control Program) Authorized by the Legislature in 1965, and responding more to several regions' fears about the San Joaquin Master Drain than local pollution or upstream diversions by water development agencies,[6/] this effort involved all or parts of the 12 counties surrounding San Francisco Bay and the Sacramento-San Joaquin Delta. That was for starters. Because of the drain, the whole Central Valley from Redding to Bakersfield had to be considered. The total area included 40 percent of California, including 60 miles of coastline to be considered for ocean outfall sites (Walsh 1972). The State Water Resources Control Board chose a consortium of engineering and financial

---

6/ The Legislature may also have been inspired to action by the imminent startup of the Central Pacific River Basins Comprehensive Project by the infant Federal Water Pollution Control Administration of the Department of Health, Education and Welfare. FWPCA official Paul W. Eastman announced the seven year, $3.5 million study at the State Board's public hearing on January 18, 1966, saying in the first three years FWPCA "will focus attention on potential pollution problems of San Francisco Bay and Sacramento-San Joaquin Delta areas."

consulting firms to produce the studies, with Kaiser Engineers of Oakland as Principal Contractor.[7/] For continuity with the SERL studies, E.A. Pearson was named Principal Consultant. The Consulting Board was chaired by John D. Parkhurst, then Chief Engineer and General Manager of the Los Angeles County Sanitation Districts.

Purpose: "Prior to that time much work had been done on the problem, but the data, considerable as it was, needed to be correlated, analyzed, and updated. A comprehensive investigation of methods to preserve not only the economics of the Valley and the Bay-Delta Area but the esthetics of one of the most magnificent coastal and valley sites on earth was set in motion" (Foreword, Preliminary Report and Prospectus, 1966). "...to determine how best to preserve not only the economics of the Valley and the Bay-Delta Area but the esthetics as well' (Walsh 1972).

Results: For the Bay, a massive regional collection and discharge scheme that was rejected by its potential beneficiaries and the array of local sewage treatment agencies threatened by it. Further, it left in its wake the legacy of "relative toxicity" that dominated Bay wastewater standard setting technology and outfall planning for the next five years or so.

7/ The associated firms included: Engineering Science Inc.; Water Resources Engineers Inc.; North American Aviation Inc.; Baxter, McDonald and Co.; Youngberg; and the University of California, Center for Real Estate and Urban Economics.

Judgment: Looking back, the contrast between the Kaiser Engineers' "conglomerate" approach and the pragmatic, public awareness approach of the San Francisco Bay Conservation and Development Commission is startling. So are the final result and the Legislative followup of the two programs. (Both studies were authorized by the same Legislature, given the same report year, and instructed to cooperate in studying and recommending what new governmental structures might be necessary.)

On the status of biological knowledge of the Bay by this time, one scientist commented:

"The Bay today is threatened not just by Bay fill and pollution. The Bay is threatened by the fact that we have been lulled into believing that we have finally gotten off the ground and gone ahead and made tremendous strides in understanding the pollution biology of San Francisco Bay. We have long gone under blind faith without any check and balance system, believing the data we are given, and assuming the competence of those gathering and analyzing this data and making the conclusions. In reality, we have produced data which is unchecked and often erroneous, and this is what we are passing on to future generations about San Francisco Bay today " (Carlton 1972).

Ready or not, the SERL and Kaiser Engineers reports, added to the regular programs of the "old" Regional Water Quality Control Board, set the stage for the very large expenditures of public and private funds of the Seventies that are cleaning up most of the municipal and industrial discharges to San Francisco Bay. According to the Regional Board "all Bay Area municipalities will have facilities capable of meeting current waste discharge requirements by 1986." 8/

However welcome this development, which got underway seriously only with passage of the Federal Clean Water Restoration Act of 1966, it must be seen as the result of applying general national and state water quality improvement programs to the Bay Area rather than the result of a Bay-centered program rising from the endemic needs of the Bay itself. 9/ But the results to date, and yet to come when the belated, massive City and County of San Francisco sewage construction program is resolved, provide a crucial advance in the process of bringing permanent, beneficial maintenance of San Francisco Bay to reality. This is the exception in an otherwise gloomy Seventies decade, as far as long-term protection of the Bay is concerned.

8/ "Our industries have provided facilities to meet the July 1977 deadline of 'best practicable treatment' and municipalities are in the midst of a $3 billion program to provide secondary or higher levels of treatment. By 1986 all Bay Area municipalities will have facilities capable of meeting current waste discharge requirements." Statement by Barbara Eastman, Chairperson, California Regional Water Quality Control Board, San Francisco Bay Region, to the State Senate Committee on Natural Resources and Wildlife, San Bruno, CA, December 12, 1979.

9/ The policy researcher in this field must not overlook the State Board's "Water Quality Control Policy for the Enclosed Bays and Estuaries of California" (reprinted April, 1979). Essentially construction guidelines, the policy is riddled with exceptions that allow discharges to the Bay that are not permissible in any other estuary of the State.

Hardin -- On coercion: "To many, the word coercion implies arbitrary decisions of distant and irresponsible bureaucrats; but this is not a necessary part of its meaning. The only kind of coercion I recommend is mutual coercion, mutually agreed upon by the majority of the people affected."

The Pro-Environmental Seventies

That brings general Bay planning up through the Forties, Fifties, Sixties and well into the Seventies, admittedly on a sketchy, backward glance basis. In that 30 years, and since, there were hundreds of specific proposals or studies for projects that somehow impacted the Bay -- whether a new sewage plant for San Jose, a new refinery on the Richmond shore, a power plant addition in South Bay, a new navigation project, a fish and wildlife resources survey, or a new urban waterfront scheme for Oakland or San Francisco. Beyond the rim of the Bay, there were hundreds of other developments upstream, large and small, that affected the quantity or quality of the Bay's waters.

In the Seventies, also, the Environmental Impact Industry was born, by State and Federal legislation. This added more (non basic) paper layers to the study of San Francisco Bay, but usefully widened public awareness of impacts on it from all sources.

A recent check of the Environmental Protection Agency's regional library showed 238 separate listings -- starting in the 1950's, except for several historic documents of earlier dates -- on the subject of San Francisco Bay. The subject San Francisco Bay Area had an additional 391 listings. Most of these are project, or project related, reports plus the benchmark Bay studies cited earlier in this paper.

Despite all these projects and studies, knowledge of the Bay's ecological systems is officially described as being "only qualitative" and, for example, lacking the quantitative merit necessary to identify "the likely beneficial effects" of unregulated outflows from the Delta to the Bay.[10/] In contrast, both qualititive and quantitative studies of the Delta's water flow needs, for ecological as well as economic purposes, have been sponsored for at least 19 years by the water development and the water regulatory agencies and twice that long by local public and private entities. There is no comparable body of knowledge for the Bay, according to the legal engineering and scientific experts advising the key decisionmaking agency.[11/]

It is tempting to say that the Delta studies have brought only peripheral benefits to the Bay, pun intended. However, the truth, as far as fresh-water inflow in concerned, is that the Bay has been saved to date by the Delta's ecological and water rights struggles. But that kind of time for the Bay is fast running out, as events of the Seventies clearly demonstrated.

10/ Water Quality Control Plan, Sacramento-San Joaquin Delta and Suisun Marsh, August 1978, State Water Resources Control Board, p. VII 14.

11/ The author believes this judgment is challengable, and that it ignores the information available from the established research program of the U.S. Geological Survey. (See footnote 5.) However, it must be accepted as the legal, scientific and political reality at this time.

The Seventies Skip the Bay

As for long-term environmental protection, the Seventies came and went without any improvement in San Francisco Bay's predicament. Possibly it got worse.

The Seventies started promisingly with the Porter-Cologne Act for water quality, the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), and the federal and state coastal management laws of 1972 mentioned earlier. But they ended with the Governor's Commission to Review Water Rights being ignored, with a water right determination that gave the Bay no interim flows,[12/] with a 10-year Delta and Suisun Marsh water quality control "plan" that contains only token, user-funded studies of the Bay's needs,[13/] with researchers finding that 50 percent of the Bay's adult striped

---

12/ Water Right Decision (WR) 1485, approved by the State Water Resources Control Board August 16, 1978.

13/ op cit. The plan requires the WR 1485 permitees, the State Department of Water Resources (DWR) and the Federal Water and Power Resources Service (WPRS), to finance the studies of the critical relationship between Delta outflow and the "beneficial uses of the Bay's waters," including the role of unregulated outflows. DWR contracts with the State Department of Fish and Game (DFG) to produce the studies, which were added to the portfolio of the Four Agency Delta Fishery Investigations (DWR, WPRS, DFG and the Fish and Wildlife Service) headquartered at Stockton. The Bay studies began operating in January 1980 "on a limited basis." In full operation, hoped for by January 1981, the financial commitment will probably amount to $570,688 per year. The same level of spending is hoped for in 1982 and 1983. (P. Herrgesell (DFG), personal communication, July 7, 1980.)

bass population suffer from parasitism, lesions and other physiological problems (Whipple et al, 1979).[14/] with the once-famous Bay-Farallones Dungeness crab fishery in its 19th straight season of decline, and with the Peripheral Canal and the San Joaquin Valley drain two decades closer to being operating realities on the overdeveloped Sacramento- San Joaquin River system.

An anomaly in this otherwise bleak assessment was the State's publication of the California Water Atlas in 1979. The atlas' 118 pages of outstanding graphics, maps and capsulized history carry on the State's lifelong romance with water and weather in fine literary style. Water development's image was never prettier. But the harsh facts of life for the 21st Century are there, too, for the careful reader.

Meanwhile, farther upstream, the renamed Federal Water and Power Resources Service (WPRS) (formerly the Bureau of Reclamation) closed out the Seventies promoting a new, economy of scale dam to enlarge Lake Shasta by 350 percent. The water would come from capturing the unregulated flood flows that now flush the Bay-Delta -- rarely, as in the winter of 1979-80 -- and carry nutrients and sediments to the ocean. The additional water would be used for irrigation, which meets the state's beneficial use laws more responsibly than simply leaving it in the river for fish and other instream and estuarine purposes.

Also, in 1980, WPRS entered its 13th year of negotiations with the operators of one of the Nation's youngest, but largest, reclamation projects -- the Westlands Water District. The task is to convert annual contracts into long term contracts to: (1) firm up the District's basic San Luis project entitlements, plus additional water the District believes it is due under a 1963

14/ The Bay's striped bass have been in decline since operation of the Federal and, later, State project export pumps began in the Delta. The striped bass are now estimated to be only one-half, or less, of the populations of the mid-1960's. For the period 1968-76, water project operations have caused an average reduction in young striped bass survival of about 40 percent, compared to the period 1922-67 (Chadwick 1979). These are the yound bass destroyed in the pumping process, lost in the salvage operations, or exported with the water. The Peripheral Canal is an engineering response to the pump-caused striped bass mortalities, in addition to its other purpose of transporting water around the Delta. Neither the canal's nor the pumps' relationships to the striped bass' other physiological problems (whipple et al) are established at this time.

memorandum signed by an Assistant Secretary of Interior; and (2) to start serious construction planning for the San Luis (project) drain. The proposed drain will terminate near Chipps Island, or at some other point in the western Delta or the Bay.

These two Federal projects, and many others existing and proposed, are affected by the Carter Administration's 1978 proposal to reauthorize the Central Valley Project (CVP). A major purpose of the reauthorization is to make it possible -- fiscally, legally and operationally, as well as politically -- for the Secretary of Interior and WPRS to meet the Delta water quality standards set by the State Water Resources Control Board. The reauthorization should also settle forever some longstanding arguments about the Federal government's responsibility for repelling salt water intrusion in the Delta (MacDiarmid 1976), which has been going on since 1957, and should expand the CVP's basic project purposes to include meeting fish and wildlife needs of the Central Valley (somehow overlooked since 1937).

The Delta Guarding the Bay

Meeting the Delta's legal and ecological requirements (WR 1485) helps assure Bay inflow from the Delta, but so do several purely physical conditions that exist today. These include: (1) the need for "carriage water" to be released into the Delta from the Federal and State reservoirs to protect the quality of the exported water, at the pumps, from salinity intrusion; (2) the need to protect the high value freshwater marsh plants needed by migratory waterfowl in Suisun Marsh by Delta outflow. However, the need for (1) could be removed with the Peripheral Canal, and (2) may be replaced by 1984, or earlier, with alternative freshwater supplies provided to the marsh by WPRS and DWR. Similarly, direct supplies are being planned for some Contra Costa County users that presently obtain water from the channels of the Delta, because the Delta's waters will become more saline with curtailment of Delta outflow.

Another Delta physical fact worth noting, one that has huge implications for the Delta's ability to yield freshwater flows to the Bay, is the stability of the levees protecting the western Delta islands. If the levees are not maintained, or repaired or replaced when they collapse as in the flood season of 1979-80, it is highly doubtful that Federal and State authorities would permit use of stored project water in the amounts necessary to repel saltwater from such a large "new Bay" on a continuing basis. Only some of the vast ecological changes of such a development are foreseeable on the basis of today's knowledge.

All the studies, projects and decisions mentioned in the previous section somehow impinge upon the water flowing from the embattled Delta to San Francisco Bay, either its quantity or its quality. In contrast to the Delta, and Suisun Marsh since 1978, there are simply no flow or salinity standards to assure the Bay's inflows from the Delta. The Delta flows to the Bay have been reduced 60 to 70 percent by upstream water use, by inbasin bypasses,[15/] and by exports from the Sacramento-San Joaquin system to the Southern San Joaquin Valley, Kern County and Southern California.

15/ Such as San Francisco's Hetch Hetchy project, of John Muir-Sierra Club infamy, and the East Bay's Mokelumne River project. These and all other upstream diverters and users are excluded from the obligations of WR 1485, and the requirements of the Sacramento-San Joaquin Water Quality Control Plan for the Delta and Suisun Marsh, which applies only to the Federal Central Valley Project and to the State Water Project as water right permittees the State Board still has some control over. This is one example of what could be described as "the water rights syndrome" that impedes effective water quality management in California.

There is no physical or legal limit to further reductions of Delta outflow. There is continuous political and economic pressure for more upstream development and more exports (Walker 1979). There is no interim or minimum protection for the Bay now. 16/

For an estuary, the amount of freshwater inflow received is critical. Without freshwater inflow it is no longer an estuary but a marine embayment. The brackish waters of estuaries provide one of the most productive and most irreplaceable environments found in nature. The San Francisco Bay-Delta estuary is the largest and most valuable estuary on the West Coast of the contiguous 48 states. (Conomos et al 1979; Seckler et al 1971; Hedgpeth 1979; Goldman 1971).

The Metered Bay Today

San Francisco Bay must depend upon the Delta for 90 percent of its natural freshwater inflows from all sources. A useful question then, given 130 years of upstream water development and diversions and 29 years of pumped exports (Storm 1970), is "How much is left for the Bay today?"

Before any significant development upstream, say in 1850, rain and snowfall in a normal weather year provided flows of 30 or 31 million acre feet (MAF) to the Delta from the 59,000 square miles of the Central Valley basin. What got to the Delta also got to the Bay, minus evaporation and evapotranspiration, but in a far different manner than it gets to the Bay today. Then the Delta was a vast tangled marshland. Today it is 60 major leveed islands, hundreds of smaller islands, a small inland sea from a drowned island, and 700 miles of navigation channels, sloughs and waterways (Bulletin 76)

16/ Presumably, this issue of whether or not the Bay is to receive flow protections will be resolved in 1988, when two years of hearings by the State Water Resources Control Board conclude. (Bay Delta Program, Schedule of Hearings and Actions, SWRCB, April 17, 1980.)

This mighty natural water system now pulses to the demands for hydroelectric power and irrigation, with occasional perturbations of man's plans by "unregulated" flood flows. For any civilization, the work done so far is an outstanding achievement. Unfortunately, it is not yet complete to man's 19th and 20th Century standards. This means there are still floodwaters escaping wastefully to the ocean, and still legally excess water flowing in the system that can be scheduled for beneficial use somewhere other than in the Delta or the Bay.

The big water projects being planned today [17], primarily sponsored by the Federal and State water development and operation agencies (WPRS and DWR), will extract another 3-5 MAF per year, maybe more, from the flows reaching the Bay in Year 2000. This brings the planned normal year range of Delta outflow to the fingercounting stage of 4 to 10 MAF per year. Of course, every conventional legal and engineering requirement will be observed in the process. And by 1990, WPRS' Large Shasta vision will begin to take on the aura of the perfect Bay-Delta rescue project, with makeup water to be provided by North Coast streams.

What happens to the Bay in such a scenario is not known. Studies of this just began in January 1980. Due to 19 years of study by the water development, regulatory and fish and wildlife agencies, the Delta's prospects are more in focus. As described in Bulletin 76 (July 1978), page 7:

> "The overall net water requirements in the Delta include internal consumptive uses and net Delta outflow for controlling salinity to protect agricultural, municipal, industrial, and fish and wildlife uses. Under the recommended plan, water necessary to meet these requirements will vary from about 4.9 cubic kilometers (4 million acre-feet) in a critical year to about 8.3 cubic kilometers (6.7 million acre-feet) in a wet year as shown in Table 2. As an area of origin, the Delta under California law has priority to available water to meet these needs before water is exported."

---

[17] Such as the Peripheral Canal and other projects in the $5-23 billions SB 200 legislation that was approved in July 1980 by the Legislature, and signed on television in Los Angeles by Governor Jerry Brown on on July 18.

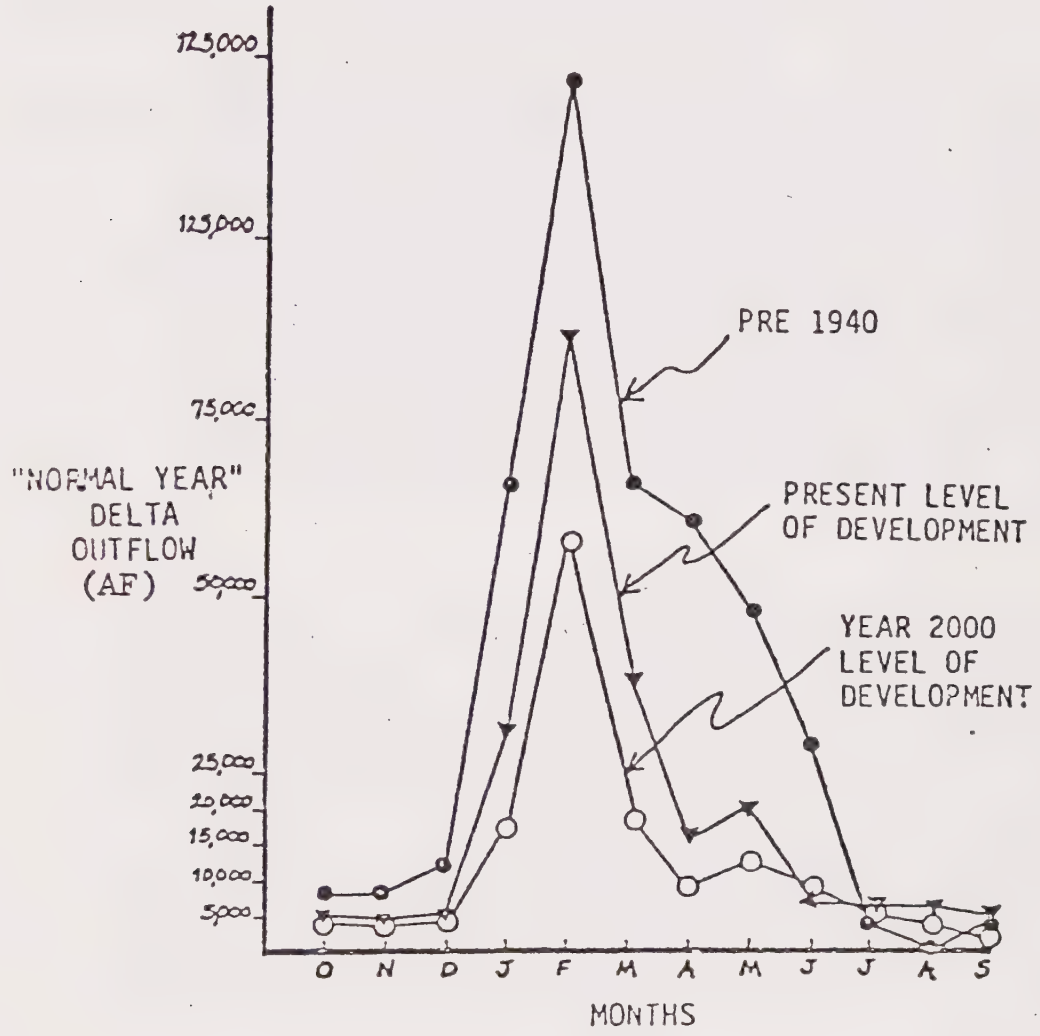
Two factors worth noting here are: (1) the Bay is not included as an area of origin under the Burns-Porter law, (2) the Delta water users do not enjoy the area of origin protection unless they pay for the water used. These are not good omens for the Bay.

Today the mythical normal weather year cited earlier brings to the Bay only 9-12 MAF, possibly less (estimates vary). In the record drought year of 1977, only 3.5 MAF reached the Bay. But even this important benchmark number is calculated, not measured, thanks to the Delta Outflow Index (DOI). Don't knock it. Its the only one we have.

The DOI was developed by the Water and Power Resources Service, in the days when it was the Bureau of Reclamation, and the Department of Water Resources. It has been used by these two agencies since 1969 in joint operations studies and other planning/management relationships. It has become the accepted empiric number on the Delta outflow, used in Delta standards setting and for other regulatory and technical purposes. Because the DOI must rely on estimating net Delta comsumptive water use in all years, and estimating some bypassed flood flows in very wet years, it is an estimate that is even less reliable in the dry and the very wet years -- the very years accuracy is most needed for planning and regulatory purposes.[18/] The actual Delta outflow may become evident soon if new acoustic measuring devises placed in the western Delta succeed in producing accurate physical measurements of Delta outflow. Overcoming some of the legal and operational complexities that now make dependence on outflow estimates necessary would be a major technical contribution to Delta and Bay water management.

18/ This dry year/wet year failing of the DOI is mentioned in the EIR for the water quality plan and WR 1485, cited earlier, as follows: "Therefore the Index is an accurate representation of true Delta outflow only when comsumptive uses match the values used in the Index. During portions of very dry or very wet years, the Index cannot be expected to be representative of true net outflow. This was the case in 1976 and 1977..." (page III-16).

The point is -- though estimates of what's left in the river for the Bay may vary, and the actual flows are not really known -- there is no doubt about the trend. (See ABAG/EMP Figure.)



Trend in Delta outflow. Values are for "normal year" (based on October 1935- September 1936). Figure from ABAG Environmental Management Plan, June 1978.

The trend has been down for 80 years and is still pointed down, resolutely. If only 30 percent of the Bay's inflow from the Sacramento-

San Joaquin remains it is certain that this will be reduced more -- to only 10 or 15 percent of that original normal weather year flow -- by the Year 2000.

Even the projections of DWR, presumably on the cautious side favoring more development,[19] place the outflow at Year 2000 level of development at less than 10 MAF in 60 percent of all years.[20] Bulletin 76 [21] sums up San Francisco Bay's present outlook as follows:

> "In summary, there are as yet no specific salinity or Delta outflow requirements for the Bay complex west of Suisun Bay that apply to the operation of the SWP or CVP. This is not to say there will be no freshwater inflow to San Francisco Bay. Controlled Delta outflow to protect designated beneficial uses in the Delta and Suisun Marsh will constitute a major source of inflow to the San Francisco Bay. Moreover, substantial unregulated flows in excess of flows for designated uses will continue in all but the driest years. These flows are estimated to average 11.6 cubic kilometres (9.4 million acre-feet) per year under 1980 conditions and 8.5 cubic kilometres (6.9 million acre-feet) per year under year 2000 conditions. The SWRCB plans to adopt guidelines for their preservation pending determination of specific needs."

19/ The State Water Project is 2 MAF short of meeting the contractual obligations that financed its construction.

20/ As cited in the final plan for "The Study of Delta Freshwater Outflow Needs of the San Francisco Bay Ecosystem", DFG, October 23, 1979.

21/ Bulletin 76 was reissued in July 1978 to support Senate Bill 346, which included the Peripheral Canal and environmental guarantees for the Delta and Suisun Marsh, in the 1977-78 Legislature. It also contains much information used by the SWRCB in WR 1485 and the water quality control plan for the Delta and Suisun Marsh, issued in August, 1978.

The ABAG Environmental Management Plan

From the Bay's viewpoint, one of the few bright spots of the Seventies has to be the $4.3 million Environmental Management Plan (EMP) that the Association of Bay Area Governments produced with Environmental Protection Agency's (EPA) "208" funding. It is reputedly the most ambitious (air, water and solid waste) 208 plan in the Nation.

This meant that ABAG[22/] entered the water business seriously for the first time. Because ABAG was not under the same kind of statutory and administrative strictures governing the Regional Water Quality Control Board (and BCDC, for that matter), the ABAG/EMP draft plan could unblushingly point out the basic function of Delta outflow in keeping the Bay healthy and call for reserving specific volumes of Delta outflows to protect the Bay future in the face of continued upstream development and exports.

22/ ABAG was created in 1961 in a Joint Exercise of Powers agreement among the counties and cities of the Bay Area. It evolved into a Council of Governments (COG) role, first, through the National Housing Act of 1964 and then through other federal programs providing financial incentives for regional planning. ABAG joined California's water industry when EPA and the State Board designated ABAG to lead its multi-resource (air, water, solid waste) Section 208 planning program for the Bay area in 1975. When this selection was made by EPA the Bay Area Sewage Services Agency (BASSA), created by the Legislature in 1971 to handle water pollution construction planning and funding, was scrapped. (From John T. Knox, Regionalism in The Bay Area.1978. Institute of Governmental Studies, University of California, Berkeley.)

The EMP also brought public attention to returning recreational and commercial shellfish harvesting to Bay Area residents, due to the progress mentioned earlier in cleaning up the municipal and industrial discharges to the Bay. (The last surviving commercial shellfish operation in South Bay closed down in 1933.) The EMP also called for a Bay Aquatic Habitats program to improve knowledge and understanding of the Bay by better management of the monitoring required of about 90 Bay dischargers. Today the State Board is implementing this program, with a request for proposals (RFP) approach to non-profit organizations, the Regional Water Quality Control Board is leading the shellfish interagency study, and ABAG itself is organizing the Bay Area's surface water control programs with counties, local districts and municipalities.

All in all, not a bad score. And there's more.

Any serious conclusions, or contrary recommendations, of the EMP on sensitive Bay issues such as Delta outflow were diluted or deleted by the State Board during the review and oversight process for "official" Section 208 water plans.[23/] Useful EMP products that were not diluted, however, include an unprecedented modeling study that verified the dependence of the Bay's -- especially South Bay's -- circulation and salinity distribution on the volume and periodicity of Delta outflows (Fischer et al 1977). [24/] This important relationship was first postulated, or demonstrated, by U.S. Geological Survey

---

23/ SWRCB Resolution No. 78-56, adopted September 25, 1978.

24/ Though the publication is listed in the references section of the SWRCB's Environmental Impact Report for the plan, and WR 1485, it is not included among the 249 citations -- going back to 1919 -- provided at the end of DWR's Bulletin 76 (July 1978).

in a 1970 report (McCulloch et al, 1970). At that time the conclusion was disputed by the State's major water official, who was supporting the Dos Rios Dam on the Middle Fork Eel and a joint Federal-State Peripheral Canal (Hedgpeth 1979).

At the same time ABAG was preparing its multi-resource EMP, with the help of numerous consultants plus a host of technical and advisory committees, the State Board was in the hearing process that led to WR 1485 on Delta water rights and the water quality plan for the Delta and Suisun Marsh. The EMP arrived in Sacramento as the Board was making its "1485" decision in the smmmer of 1978. Presumably, ABAG's EMP did serve to remind the Board of the Bay's historically neglected needs, and thus helped in gaining the minimal recognition of the Bay's problems that can be found in WR 1485 and in Section VII of the plan.

At least one ABAG statement was submitted to the Board, on July 11, 1977, by John Davis and B.J. Miller (now vice chairman of the SWRCB). It is a generally good statement, in that it cites the Fischer model report findings and other recent data related in some way to Delta outflow. However, its brief recommendation does not request the Board to set specific interim flow standards to protect the Bay while the studies and analysis ABAG calls for are being produced.[25/]

25/ The ABAG statement also quotes from an interesting report prepared by D.W. Kelley and W.E. Tippets on Delta outflow and Bay-Delta biology. (Delta Outflow and San Francisco Bay. Sacramento: April 1977) Though the Kelley-Tippets study was done nominally for the Delta Environmental Advisory Committee (DEAC), which is an official advisory group to DWR, like the Fischer report it is not listed in the references for DWR's Bulletin 76 (July 1978). Kelley and Tippets flatly recommended to DEAC, on an interim basis, that "a minimum reservation is one million acre-feet per month for two consecutive winter months" with exceptions for critical years.

The ABAG Legacy and the BCDC Gap

Though it may be premature to talk about an ABAG legacy, the ABAG/EMP adventure did bring home some bay and Bay Area facts of life worth remembering.

When the Porter-Cologne Act reorganized California's water quality and quantity programs, responding to Federal imperatives on water quality and to State imperatives on water rights, it shifted the balance of power on water quality away from the nine regional boards. Though there were some good and necessary reasons for this, statewide, it removed any possibility of the Bay Area having a Regional Board that could take an advocacy role on behalf of the Bay as a body of water. The Regional Board's role was set: it would deal only with controlling and monitoring sewage outfalls and other point source discharges, and help channel State and Federal public works funds to deserving local governments and special districts as they participated in the largest public works program in the history of the world. Such issues as Delta outflow -- or any issues involving other regions' waters or the sacrosanct subject of water rights -- were reserved for State Board jurisdiction only.

Similarly, the powers given to BCDC by the same Legislature restrict it to shoreline planning or fill control, but with no authority over the Bay's future as a body of water except to try to maintain its size and tidal prism. BCDC's role in water quantity or quality issues, unrelated to fill or shoreline use, is purely advisory and, occasionally, political.

This was evident in late 1978 -- after the WR 1485 and its symbiotic water quality control plan were approved by the State Board, and while DWR and the Brown Administration were supporting SB 346 in the Legislature. At that point BCDC was organizing a heterogeneous group of agencies to support new

Bay scientific studies. The vehicle was to be a group letter, or identical letters submitted by the participants individually, to the State Board and DWR.

Some weeks later, instead of a group letter, BCDC Chairman Houghteling sent a BCDC letter (12-11-78) to DWR and SWRCB that requested them to make funds available for "an initial survey ... to identify all Bay elements that would be potentially affected by significant permanent changes from historical Delta outflows."

In view of the home loyalties of about half of the participants, it is not surprising that an effective group letter was slow in coming. In addition to the expected major State agencies, such as DWR, SWRCB and DFG, the participants included Contra Costa County Water District, Contra Costa County, North Delta Water Agency, the Metropolitan Water District of Southern California, and the Santa Clara Valley Water District -- all either State Water Project contractors or Delta opponents to the SWP (and CVP). Also included in the effort were the East Bay Municipal Utility District and San Francisco's Hetch Hetchy Water and Power Department. Both of these early-day water development agencies get their water in pipes and conduits that bypass the Delta, so their primary interests lie in simply maintaining their present free-ride on Bay-Delta problems.

No doubt the BCDC effort had some useful effect, but probably the only participants that followed BCDC's example with similar letters of their own were the League of Women Voters, the Sierra Club and the Environmental Defense Fund.

Any reader who has reached this point will not be surprised to learn that the Seventies ended with a $2 million Bay Area Water Reuse Study sliding noiselessly from Phase One to Phase Two. This is an economic and engineering

feasibility investigation, managed by CH2M Hill, to determine if the now-cleaned-up water flowing to the Bay from 31 municipal outfalls -- 530 million gallons per day -- can be captured for some beneficial use. Elsewhere, of course. There is also a Valley regional group tied into the study, interested in using the water there instead of letting it flow wastefully into the Bay. Potentially, about 500,000 acre feet of reuse water is involved.

The benefits of the water applied to farm fields for crops in the southern San Joaquin Valley, which can be easily computed, appear to have the edge at the moment over other contenders. Of course, the benefits, if any, of leaving this water in the Bay are not easy to compute and this has not been analyzed yet. Similarly, using the reclaimed water for such high-minded but low-pay purposes as bayside marsh restoration has a hard time competing in the real world of water economics.

However, rising energy costs offer hope. They may mean that the water can only be pumped upstream as far as the western Delta. There it might be sold or exchanged to WPRS and DWR, to help them meet Delta water quality standards. But the volumes are really small to affect the massive tidal/freshwater mixing zone much, so maybe the reclaimed waters can be used to dilute the agricultural drainage effluents coming to a western Delta or Bay outfall when the San Joaquin Valley drain is completed.

The opportunities are almost unlimited. But no doubt the study's 14 "joint powers" partners on the Bay -- county, municipal and special districts, State, Regional and Federal agencies -- will identify the one or two that (1) make the most cost-benefit sense, and (2) make the least disturbance of the status quo.

Reflections on CEQA, Porter-Cologne and the Bay

Looking back from 1980, CEQA, Porter-Cologne and the water pollution cleanup of the Seventies did impact the Bay in at least three unexpected ways:

1. From CEQA, BCDC got the legal clout it needed (and still does not have itself) to require mitigation from public and private developments that impact Bay resources. This is one of the most marked contrasts between BCDC and its political offspring, the Coastal Commissions. They have mitigation authority within their own statutes, plus CEQA. This, on top of the narrow, patchwork shoreline jurisdiction of BCDC's 1969 plan, results in a wide discrepancy between the two agencies' powers to protect coastal resources, such as wetlands, which have the same fundamental social and economic values to the people of California and the Nation whether they happen to exist on the Bay or on the open ocean shoreline.

   Similarly, the sloughs, waterways, bays and estuaries under the Coastal Commissions' jurisdiction enjoy some protections, as bodies of water, against damage by upstream developments that BCDC can only dream about at this point.

   Speculation is cheap, but possibly, if CEQA had not come along with the mitigation needed to make the BCDC plan work, BCDC's jurisdiction today would more resemble that of the Coastal Commissions. Instead, BCDC's need for authority has been downplayed since 1972 so as not to rock the Coastal Commission boat in the Legislature or in the Governor's Office.

2. By modernizing California's water administrative structure, as mentioned earlier, the Porter-Cologne Act assures that no parochial Regional Board can champion the Bay's cause against all others. But Porter-Cologne and its companion Federal standards and funding programs have removed one of the most powerful arguments that California's organized water interests, especially agriculture, have applied historically to the question of leaving some flows in the river for the good of the Bay. It is usually expressed:

> "Why should we let this good water go wasting to the ocean, water we need and can claim legally, just to flush your pollution out of San Francisco Bay?"

Or, apropos the San Joaquin Valley Drain project and the Bay:

> "Your Bay is so polluted anyway this little bit won't hurt it."

This issue, like the water itself, is much clearer now.

3. Nowhere is the basic conflict between the two major classes of beneficial uses of water in California more obvious or more important than in San Francisco Bay's case -- though, for poignancy, the Bay can hardly match Mono Lake's predicament. Porter-Cologne is the State's major effort to date to cope administratively with the anomalies of meeting the State Constitution's "reasonable beneficial use(s)" dictum. Since 1967 the SWRCB has had both jobs of determining water rights and defining and protecting water quality. Neither is an easy task. Together they may prove to be impossible.

For public health and quality of life purposes, the Bay boasts a dozen or more public "beneficial uses" that qualify for protection under the newer State and Federal water quality laws. These range from providing public swimming, and edible fish to being an odor-free amenity to be enjoyed for that reason alone by 5 million people every day. These are the only "rights" the Bay has. 26/

Under the water right laws there are other, older "beneficial uses" upstream. Obviously, these can and do drastically affect the Bay's beneficial uses. These older uses -- a contradiction of terms, certainly, except in the sense of western legal history used here -- enjoy the same, or even a higher, level of protection as property rights. This is despite the fact that the water so used (85 percent for agriculture statewide for example) is a no-cost public good given away in the first place and impacting many other private and public rights in the second place.

Philosophy aside, in the Bay scenario the two types of beneficial uses, e.g. quality v. quantity, are moving the conflict toward center stage. But so far, in the arbitration process that controls the State Board's management policies, the only actors visible are the Streamside Diverters (SD's), represented by DWR and WPRS, and the Bayside Dischargers(BD's) to be represented soon by a non-profit research organization. Both groups are functioning under the quidance and nominal control of the State Water Resources Control Board.

26/ The values of such Bay uses are rarely quantified, though at least one economist has made a start (Meyer 1979), and others have been aware of the problems generally since the Forties (Bollman 1971:88).

The SDs officially began their studies in January 1980, as noted earlier, when the SWRCB ordered them to do so in WR 1485 and the water quality control plan approved in August 1978. The BDs are now being organized by SWRCB and the Regional Board, through the RFP process mentioned earlier, and should be in full operation, after an organizing year,by August 1981. The SDs, in the tradition of and using the same methodology that brought the Striped Bass Index and "fish flows" to the Delta (in the Four Agency studies operating there since 1961), have the unenviable task of paying for and helping to determine the amount of unregulated Delta outflows needed to protect "all beneficial uses" of San Francisco Bay. Since the two river operating agencies, DWR and WPRS, are responsible for about half of the diversions from the river today, presumably they will be expected to meet 50 percent, or more, of any proved outflow need from the Delta. So far, all other SDs have escaped even the hint of any obligation to provide for maintenance flows to the Delta or the Bay. Perhaps <u>that</u> water quality/quantity arbitration is the one that will dominate the Nineties, especially if the historic trend, confirmed in the Delta, holds true of man's increasing knowledge leading to stiffer water quality requirements (Kaiser Engineers 1969: IX-1).

The BDs are working at the other end of the pipe, so to speak, and are expected to support the studies needed to determine how various levels of Delta outflow affect, and are affected by, their discharges to the Bay. Both parties will be main forces, perhaps the only ones with the preferred "quantified" data on Delta outflow, when the issue of Bay-Delta standards is joined in the two years of SWRCB hearings that open in August 1986.

Thus, at this writing the only official momentum to analyze the Bay's entitlement to Delta outflow relies upon two very interested classes of water users, simplified here to SDs and BD's. The Board's task representing the public's interest in the Bay, presumably, will consist mainly of making Solomon-like judgments based on the evidence the Board itself is now directing the SDs and the BDs to prepare, present, and defend -- plus whatever any other parties of legal interest may submit. It is doubtful the Bay can win much in such a process, which is based primitively upon all affected parties avoiding any new obligations to take care of the Bay commons.

Conclusion #1

The Bay's shoreline and aquatic problems in the Eighties are worthy of the same level of public and private effort of the Sixties that produced BCDC. The Bay protective agency should be given the specific new shoreline and other authority it needs to perform the task the public thinks it now has the power to perform.

For the sake of legal uniformity, sound ecological planning, and simplifying government procedures for confused permit applicants, BCDC's shoreline control over wetlands should match that of the Coastal Commissions' over all other coastal wetlands of California. Also, this would resolve most of the present BCDC-Federal conflicts over jurisdiction (Corps of Engineers) over the Bay's wetlands.

Conclusion #2

Given the long established trend, given the determination and capitalization of water development interests, given the competition between two giant public water projects reporting to different political masters, given the dedication of major sections of the water industry to finding ways to study old problems rather than finding new answers, given the shelter provided for inefficient, wasteful and non-ecological water uses by the most archaic water right laws of the West, and given the fragmentation of responsibility for San Francisco Bay's future among a dozen or more agencies, the conclusion is inescapable that the record annual low Delta outflows of 3.5 MAF in 1977 and 4.85 MAF in 1931 have become the subliminal, if not the actual, planned base flow for the once mighty Sacramento-San Joaquin river system in the hypothetical normal weather year.

The effects of this on the Bay are not known. There are indications that the removal of 60 to 70 percent of normal year inflow to the Bay in the past is now having serious, perhaps irreversible systemic effects on the biological, physical, social and economic values of the Bay. This is 1980. Official "future" water planning covers the next 20 years.[27/] The Bay will be a different body of water then, possibly forever.

27/ "Our final planning caveat is that forecasting the future is a risky business. Naturally, it is not as risky as not forecasting the future, but we must plan for realistic periods of time. Our current efforts are for the period until 2000. Even within that limited framework, it is important to consider 'alternative futures', or more than one set of circumstances." Ronald B. Robie, Director, California Department of Water Resources. 1978.

Conclusion #3

It may take a renaissance of the citizen movement of the Sixties to change the grim prospects facing the largest and most valuable estuary on the West Coast of the United States of America in the Eighties. As a minimum, the mosaic of government agencies supposedly protecting some Bay parameter should be mobilized to concentrate their efforts. The Bay simply does not have the 19 years the water development, regulatory, research and fish and wildlife agencies devoted to studying the Delta's needs. By the State's official schedule, as much must be accomplished for the Bay in six years as has been accomplished for the Delta in 19 years. Obviously, there is not time left for applying traditional methodology to establish cause and effect, or to determine responsibility and mitigation, beyond reasonable doubt.

Thus, uncertainty will dominate all major decisions affecting the Bay in the next 20 years.

Conclusion #4

Only an innovative approach that begins to identify and characterize the Bay's present values, that can predict and define its biophysical conditions, and that can devise safer public strategies to deal with the Bay's uncertain future can begin to offer hope for building a post-year 2000 program for San Francisco Bay.

One such approach has been developed by the U.S. Fish and Wildlife Service (Davoren 1980). This "Bay Institute" proposal is under consideration by four Federal agencies (FWS, Corps of Engineers, Environmental Protection Agency, and the National Marine Fisheries Service) and four State and regional agencies (Association of Bay Area Governments, Bay Conservation and Development Commission, Department of Fish and Game, and the Regional Water Quality Control Board). In its present form the proposed institute could be supported by (1) financial and staff contributions of the cooperating agencies, (2) other government research and development funding, (3) private foundation support, or (4) combinations of (1), (2), and (3).

* * *

Perhaps the purposes of a Bay Institute in 1980 are no more unusual than were the purposes of the founders of the American Association for the Advancement of Science in 1848 (AAAS 1980), though operating in a vastly different scale, application and timeframe:

> "...to give a more systematic direction to scientific research in our country" and to help scientists by "increased facilities and a wider usefulness."

\# \# \#

LITERATURE CITED

Association of Bay Area Governments 1978. Environmental management plan, Berkeley. 556p.

Bollman, F.H. 1971. On demand for water in its natural environment. In: D. Seckler (ed.), California water, Univ. of Calif. Press. Berkeley. 348p.

California Coastal Alliance 1972. Proposition 20, Coastal Zone Conservation Act, Woodside, CA.

California Department of Fish and Game. 1979. Protection of San Francisco Bay fish and wildlife habitat. With US FWS, prep. by Jones and Stokes Associates. Sacramento. 2 vol.

California Department of Water Resources. 1978. Delta water facilities, program for Delta protection and water transfer, water conservation, water recycling, surface and ground water storage. Bull. 76. Sacramento. 245 p.

California Governor's Commission to Review Water Rights Law, final report. Sacramento, CA, December 1978.

California Legislature. 1965. California Water Pollution Control Law.

_____. 1969. San Francisco Bay Conservation and Development Commission Act. Sacramento.

_____. 1970. Environmental Quality Act. Sacramento.

_____. 1976. Coastal Act. Sacramento.

California Office of Planning and Research - Department of Water Resources. 1979. California water atlas. Sacramento. 118 p.

California San Francisco Bay Conservation and Development Commission. 1969. San Francisco Bay Plan. San Francisco. (Reissued 1979.)

California Water Quality Control Board. 1966. San Francisco Bay-Delta water quality control program, preliminary report and prospectus. 187 p.

California Water Resources Control Board. 1978. Water right decision 1485. Sacramento-San Joaquin Delta and Suisun marsh. Sacramento.

_____. 1978. Water quality control plan Sacramento-San Joaquin Delta and Suisun marsh. Sacramento.

_____. 1978. Environmental impact report, water quality control plan and water right decision, Sacramento-San Joaquin Delta and Suisun Marsh. Sacramento.

_____. 1978. Appendix: summary of public comments on draft water quality control plan and environmental impact report, Sacramento-San Joaquin Delta and Suisun marsh. Sacramento.

_____. 1978. Order WR 78-17 denying reconsideration of WR 1485. Sacramento.

_____. 1979. Porter-Cologne water quality control act. 115 p.

Carlton, J.T. Current status of marine pollution research in the San Francisco Bay area. In: proc. San Francisco Bay and Estuarine Association. 4/20/72. Sacramento.

Chadwick, H.K. 1979. Fish and wildlife perspectives on Delta water facilities, statement to California Assembly Comm. on water, parks, and wildlife. 4/4/79. Sacramento.

CH2M Hill, Inc. 1979. Summary San Francisco Bay area water reuse study. With Jefferson Associates, Inc., San Francisco. 8 p.

Conomos, T. J. (ed.) 1979. San Francisco Bay: the urbanized estuary. AAAS. San Francisco. 493 p.

Conomos, T. J.; Smith, R. E.; Peterson, D. H.; Hager, S.W.; and Schemel, L. E. 1979. Processes affecting seasonal distributions of water properties in the San Francisco Bay estuarine system. p. 115-142 In. T. J. Conomos (ed.) San Francisco Bay: the urbanized estuary. AAAS. San Francisco. 493. p.

Conomos, T. J. 1979. Properties and circulation of San Francisco Bay waters. p. 47-84. In: T. J. Conomos (ed.) San Francisco Bay: the urbanized estuary. AAAS. San Francisco. 493 p.

Davoren, W.T. and Meyer, P.A. 1980. A bay institute discussion paper number two. Unpublished. US FWS Tiburon, CA. 10 p.

Eastman, P. J.; McCarty, J. C. 1966. Statement to Water Quality Control Board and California Water Commission joint hearings. 1/19/66. Federal Water Pollution Control Administration. San Francisco.

Fischer, H. B.; Imberger, J.; Kirkland, W. B. Jr. 1977. Effect of delta outflow on the density stratification in San Francisco Bay. Association of Bay Area Governments. ABAG-HBF-77/02. Berkeley. 109 p.

Goldman, C.R. 1971. Biological implications of reduced freshwater flows, San Francisco Bay-Delta system. In: D. Seckler (ed.), California water, Univ. of Calif. Press. Berkeley. 348 p.

Hardin, G. 1968. Tragedy of the commons. AAAS. Science p. 1243-1248. Washington D. C.

Healy, R. (ed.) Protecting the golden shore. The Conservation Foundation, Washington D. C. 1978. 259 p.

Hedgpeth, J. W. 1979. San Francisco Bay -- the unsuspected estuary, a history of researches. p. 9-29. In: T. J. Conomos (ed.) San Francisco Bay: the urbanized estuary. AAAS. San Francisco. 493 p.

Horne, A. J. and S. J. McCormick. 1978. An assessment of eutrophication in San Francisco Bay. Association of Bay Area Governments. Berkeley. 1978. 96 p.

Kaiser Engineers. 1969. Final report to the state of California, San Francisco Bay-Delta water quality control program. Oakland. 483 p.

Knox, J. T. 1978. Regionalism in the Bay area. In: Four persistent issues, University of California, Institute of Governmental Studies. Berkeley. 79 p.

McCulloch, D. S., Peterson, D. H. Carlson P. R. 1970. Preliminary study of the effects of water circulation in the San Francisco Bay estuary. U.S. Geol. Surv. Circ. 637 A. 27 pp.

MacDiarmid, J. MacL. 1976. The California state water project: development, description, current conflicts. In: proc. 62nd Annual Conference of National Council for Geographic Education, San Francisco, Nov. 27, 1976.

Meyer, P.A. 1979. The value of fish and wildlife of San Francisco Bay, a preliminary survey. US FWS, California Water Policy Center, Sacramento, CA. 21 p.

_____. Science, ignorance and bounding investigations into bay systems. Unpublished. Presented to NMFS seminar, La Jolla, CA May 6, 1980. US FWS, Tiburon, CA. 17 p.

_____. 1980. Management, uncertainty and San Francisco Bay. Unpublished. Presented at the 1980 meeting of the San Francisco Bay and Estuarine Association, Davis. June 25, 1980. US FWS, Tiburon, CA. 18 p.

Nichols, F. H. 1973. A review of benthic faunal surveys in San Francisco Bay. U. S. Geol. Surv. Cir. 677. 20 pp.

Pearson, E. A. 1958. Reduced area investigation of San Francisco Bay, for State Water Pollution Control Board, Berkeley. 328 p.

_____. 1972. San Francisco Bay - estuarine-coastal waste management problems. In: course materials for water resources engineering educational series, University of California, Berkeley. March 7-9, 1972.

Robie, R. B. 1978. Water issues facing California. In: Four persistent issues, University of California, Institute of Governmental Studies. Berkeley. 79 p.

Seckler, David (ed.) 1971. California water, a study in resource management. University of California Press. Berkeley. 348 p.

Storm, D.R. 1970. Management study of a transitional Delta system. In: Hydrology of deltas. Symp. Bucharest (1969). LASH/AIHS - Unesco. Paris.

University of California. Sanitary Engineering Research Laboratory (SERL). 1961-69. A comprehensive study of San Francisco Bay, for State Water Pollution Control Board. Berkeley. 6 vol.

_____. An investigation of water and sediment quality and pollutional characteristics of three areas in San Francisco Bay 1960-61, Berkeley. 1962. 571 pp.

U. S. Department of Interior, Federal Water Pollution Control Administration. 1967. San Joaquin master drain, effects on water quality of San Francisco Bay and Delta, San Francisco. 139 p.

_____. Bureau of Reclamation. 1978. Special task force report on San Luis unit, central valley project, California. Washington D. C. 331 p.

Walker, R. and M. Storper. 1979. The California water system: another round of expansion? Institute of Governmental Studies, Univ. of Calif. Berkeley. Public Affairs Report, Vol. 20 No. 2. 11 p.

Walsh, Raymond B. 1972. San Francisco Bay-Delta water quality management program. In: course materials for water resources engineering educational series, University of California, Berkeley. March 7-9, 1972.

Whipple, J.; Eldridge, M. B.; Benville, P. E. Jr.; Bowers, M. J.; Jarvis, B. M.; Stapp, N. R. 1977. Effects of inherent parental factors, including pollutant uptake, on gamete condition and viability in striped bass. National Marine Fisheries Service. Tiburon.

Wilmar, M. B. 1980. BCDC's experience in shoreline management: problems and opportunities. AAAS symp. Davis, CA. San Francisco Bay Conservation and Developemnt Commission. San Francisco.

U.C. BERKELEY LIBRARIES
C12489611